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LIGHT WEIGHT PORTABLE PHASED ARRAY ANTENNA

TECHNICAL FIELD

[0001] This invention relates generally to an antenna system and in particular to a light weight portable phased array antenna system for receiving high bandwidth signals from satellites.

BACKGROUND

[0002] Although antenna systems that use light communication channels in combination with phased array antenna elements have already been implemented, thus far none of these antenna systems have been adapted to form a portable lightweight collapsible unit. Such a configuration is desirable to provide convenient and portable access to movies on demand or internet service for campers, hikers, travelers and others who may find themselves in remote areas where other communication connections are not readily available. The antenna system of the present invention is easily assembled and disassembled and compact for transporting.

SUMMARY

[0003] The present invention provides an antenna system for receiving communication signals from satellites, the antenna system having a plate of light channel material that is formed from a plurality of subplates, a plurality of antenna nodes supported on the top surface of each of the subplates, and an electronic control unit to which the subplates are fixed and aligned and a

collapsible support stand fixed to the bottom of the electronic control unit opposite the subplates, the subplates, antenna nodes, electronic control unit and stand interconnecting to form a lightweight antenna assembly that may be disassembled into easily portable components.

[0004] These and other aspects and advantages of the present invention will become apparent upon reading the following detailed description of the invention in combination with the accompanying drawings.

BRIEF DESCRIPTION OF THE FIGURES

[0005] Figure 1 is a three dimensional graphic representation of a portable light weight phased array antenna assembly;

[0006] Figure 2 is a three dimensional exploded view of the antenna assembly showing the electronic control unit and the LCC subplates;

[0007] Figure 3 is an exploded top view of the phased array showing the metal conductors or traces that connect the antenna nodes and the electronic control unit;

[0008] Figure 4 is an exploded bottom view of the antenna assembly showing the alignment features for the LCC subplates;

[0009] Figure 5 is an exploded view of the collapsible support stand and the electronic control unit with a partial view of two of the subplates;

[0010] Figure 6 is a partial cross-sectional view of a subplate taken along section arrows 6-6 of Figure 5.

[0011] Figure 7 is a functional block diagram depicting the operation of one of the antenna's nodes in receiving mode.

[0012] Figure 8 is a functional block diagram depicting the operation of one of the antenna's nodes in transmitting mode.

DETAILED DESCRIPTION

[0013] The following description of the preferred embodiments of the inventive system is not intended to limit the inventive system to these preferred embodiments, but rather to enable any person skilled in the art of phased array antenna systems to make and use the inventive system.

[0014] Referring to Figure 1, the light weight portable phased array antenna assembly or antenna system 10 for receiving high band width signals from satellites is shown fully assembled and standing upright on its collapsible support stand 20. The preferred embodiment of the antenna system 10 includes a plurality of small dipole antenna elements or antenna nodes 30 that form a phased array 40 for transmitting and receiving signals. Each of the antenna nodes 30 of the phased array 40 is located and supported in a fixed and certain position on a plate 46 of light channel communication (LCC) substrate material.

[0015] As shown in Figure 2, the LCC substrate plate 46 in the preferred embodiment is actually made up of four subplates 50a through 50d, each comprised of LCC

substrate material. The LCC substrate plate 46, however, could be made by one skilled in the art using any number of subplates 50.

[0016] The LCC substrate plate 46 is detachably fixed to the collapsible support stand 20. The combination of the LCC substrate plate 46 and the detachable and collapsible support stand 20 allows the antenna system 10 to be easily assembled and disassembled into a compact unit for ease in transport. The construction of the LCC substrate plate 46 from the four subplates 50a through 50d further facilitates the easy transport of the antenna system 10.

[0017] Each of the plurality of antenna nodes 30 communicates through one of the LCC subplates 50a through 50d with a central processor or electronic control unit 60 that combines the signals, calculate deviations in location and direction and send control signals back to the antenna nodes 30 allowing the plate 46 supporting the phased array 40 to be re-directed or re-pointed. Use of light channel technology to form the substrate subplates 50a through 50d makes the preferred embodiment of the inventive antenna system 10 light weight and portable.

[0018] The material making up the subplates plates 50a through 50d in the preferred embodiment is a light-weight light channel communication (LCC) substrate material such as polycarbonate, PETG (glycolized polyester – polyethylene terephtalate with glycol modifiers) or acrylic (polymethyl methacrylate), but its functionality could easily be accomplished through the use of any other strong and light-weight material that is a good conductor of light. The LCC substrate

material making up the subplates 50a through 50d channels or conveys the signal information from each of the antenna nodes 30 to the electronic control unit 60 for data processing. Using the LCC substrate material to comprise the subplates 50a through 50d eliminates the need for circuit boards or wiring harnesses that can often be large, heavy and bulky.

[0019] As seen in FIG 3, the LCC substrate material forming the plate 46 and its comprising subplates 50a through 50d also supports metal conductors or traces 70. The metal conductors or traces are routed to each of the antenna nodes 30 to provide transmission pathways for power. The conductors 70 may be implemented as printed conductive polymer, electroplated traces, flat wire or flexible circuit material that is bonded directly to the LCC material of the subplates 50, or in any of the other ways that are well known to one skilled in the art of antenna systems.

[0020] As shown in FIG. 2 and FIG. 4, the four separate substrate plates 50a through 50d of the preferred embodiment are each aligned with and connected to the housing of the electronic control unit 60 to form the complete substrate plate 46 and phased array 40. The alignment features 92 on the back of each subplate 50a through 50d position and aid in securing each of the subplates 50a through 50d to the housing of the electronic control unit 60. Each of the alignment features 92 mates with a subplate alignment hole 93 on the housing of the electronic control unit 60 to mechanically align the subplates 50a through 50d.

[0021] Referring now to FIG. 5 and FIG 6, each of the antenna nodes 30 communicates with the main electronic control unit 60 by means of conductive traces or conductors 70 that are routed from each of the antenna nodes 30 to an interconnect pad 71. Each of the interconnect pads 71 is connected to a duplicate interconnect pad 72 on the under side of the LCC subplate 50a through 50d by means of a copper plated through hole 73. The duplicate interconnect pads 72 are in turn each connected to one of a plurality of conductor pads 80 embedded in the housing of the electronic control unit 60 using any one of the many known methods of interconnection, such as by way of example, connectors or press fit pins, thereby completing a communications path from each of the antenna nodes 30 to the electronic control unit 60 that processes the signal data. The electronic control unit 60 is located and secured to the collapsible support stand 20 through means of a central locator pin 94 that mates with a central alignment hole 95 in the housing of the electronic control unit 60

[0022] Also shown in FIG 5 is an emitter/transmitter LED 90 that transmits signals from the electronic control unit 60 to the plurality of antenna nodes 30 that form the phased array 40. Conversely, receiver LEDs 91 receive signals from the plurality of antenna nodes 30 in the phased array 40 and convey these signals to the electronic control unit 60.

[0023] The node electronics 100, 101 shown in FIG. 7 and FIG. 8 are provided for each of the antenna nodes 30 in the phased array 40. The node electronics 100, 101 functionally support the transmitting and receiving functions of its

respective antenna node 30 and are preferably contained in the respective antenna node 30, but alternatively could be attached on, to or near a corresponding conductor 70 on the LCC subplates 50.

[0024] Referring now to FIG. 7, each of the receiving node electronics 100 consists of a dipole element 110 attached to a low noise amplifier 120, which in turn feeds a programmable phase delay element 130. The output of the phase delay element 130 modules the output of a light emitting or laser diode 140 that is coupled to the LCC material of the subplate 50. The light is gathered and combined at the receiver LEDs or diodes 91, which couple the signal to detector/demodulation circuits within the electronic control unit 60. The electronic control unit 60 processes the signal to produce the resultant broadband signal.

[0025] A local processor 170 within the receiving node electronics 100 receives signals from the electronics control unit 60 via a pin 160 within the receiving node electronics 100. The local processor 170 calculates the appropriate delays for the dipole element 110 and modulates an LED/transceiver to send that information back to the appropriate antenna nodes 30 in the phased array 40 in order to "point" the antenna node 30. The adjustment in the angle of the phased array 40 is controlled by microprocessor controlled phase delay lines contained in the electronic control unit 60. Alternatively, the means to control of the angle of the phased array 40 could be contained in or affixed to the collapsible support stand 20.

[0026] Referring to FIG. 6, the transmit function of the node electronics 101 is shown to operate in manner that is similar to the receiving function of the node electronics 100 depicted in FIG 5. The main electronic control unit 60 sends signals via the LCC subplates 50 to each of the antenna nodes 30 providing the delay information to point the antenna system's 10 substrate plate 46 and phased array 40 in the correct direction. The transmit signal is also conveyed to a transmit antenna node 30 where it is delayed, amplified and conducted to the dipole element.

[0027] The preceding description of the preferred embodiments of the inventive system is not intended to limit the inventive system to these preferred embodiments, but rather to enable any person skilled in the art of phased array antenna systems to make and use this invention. As any person skilled in the art of phased array antenna systems will recognize from the previous detailed description and from the figures and claims, modifications and changes could be made to the preferred embodiments of the inventive system without departing from the scope of this invention system defined in the following claims.